REMARKS

Claims 1, 2, 4, 6-15, 17-21 and 24-32 are pending in the application. All pending claims stand rejected. Claims 7, 18, 20, 24 and 25-28 are amended. Claim 21 has been cancelled thus leaving claims 1, 2, 4, 6-15, 17-20 and 24-32 remaining in the case. Reconsideration and allowance of all pending claims in view of the amendments and foregoing remarks is respectfully requested.

Claim 20 has been amended to address informalities recited in Office Action.

Claim Objections and Rejections – 35 USC § 112, first paragraph

Claims 1, 2, 4, 6-15, 17-21 and 24-32 have been rejected under 35 U.S.C. 112, first paragraph, on the grounds that those claim contain subject matter which was not described in the specification in such a way as to reasonably covey to on skilled in the relevant art that the inventor(s), at the time application was filed, has possession of the claimed invention.

The following claim limitations were noted: (1) "for removing carbon remaining in the lower electrode" [claims 1, 13 and 20]; (2) "inherent temperature" [claims 7, 18, 24 and 25]; (3) "and surface form of the lower electrode does not substantially change be the pre-annealing" [claim 20]; and (4) "the inherent crystallizing temperature of the tantalum oxide layer is over 700°C" [claim 25]. Support for these limitations are in fact found in the specification or understood to those knowledgeable in the art as noted in turn below.

Support for "pre-annealing for removing carbon remaining in the lower electrode" is found with applicant's specification in the paragraph starting on page 2, line 32 where it is disclosed that the impurities such as carbon are "produced in the lower electrode" and that "the impurities can be removed from the surface of the lower electrode by a pre-annealing" (page 3, lines 21-22 and page 11, lines 27-29).

The term "inherent temperature of crystallization annealing" should be well known to those skilled in the semiconductor and material science arts as the temperature at which a particular material by itself would undergo crystallization annealing. Use of the term "inherent" should not constitute new matter since such a term is well known in the art. An explanation of the difference between the crystallization temperature used in the inventive method and the *inherent* crystallization temperature of the material was described in the previous response but is supplemented herein. That is, it has been shown experimentally that the crystallization temperature for the dielectric is actually lower than the inherent crystallization temperature of the material due to formation of a dielectric (e.g. tantalum oxide) along a grain boundary of the pre-annealed lower electrode where the dielectric

becomes partially crystallized. This partial crystallization decreases the crystallization temperature so that the actual crystallization temperature is lower than the inherent crystallization temperature.

Claim 20 has been amended so that "surface form" now reads "surface morphology" as supported with reference to FIGs. 8A and 8B (see, e.g., page 11, lines 9-14).

Claim 25 has been amended to correspond with page 2, line 24 of the specification denoting the inherent temperature of crystallization using prior art processes.

Removal of the §112, first paragraph rejections are respectfully requested in view of the above remarks.

Claim Objections and Rejections – 35 USC § 112, second paragraph

Claims 7, 18, 21, and 24-29 have been rejected under 35 U.S.C. 112, second paragraph, on the grounds that those claims are indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regard as the invention.

Claim 21 has been cancelled thus obviating the §112, second paragraph rejection. Removal of the rejection is requested.

Turning to the remaining claims rejected under §112, second paragraph, the Examiner has posed the question, "How can an annealing temperature be lower than itself?" It is hoped that the amendments to the claims, combined with the above explanation, will clarify that the actual crystallization temperature applied to the deposited dielectric is lower than the inherent crystallization temperature of the material by itself. Accordingly, removal of this §112, second paragraph rejection with respect to claims 7, 18, 21 and 24-29 is respectfully requested.

Claim Rejections – 35 USC § 103

Claims 1, 2, 4, 6-15, 17-20 and 30-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Agarwal et a. (U.S. Pub No. 2002/0037630) of record in the view of Applicant admitted prior art.

Applicant believes the following holdings, among others, to be incorrect:

Paragraph 8: With respect to claims 1 and 13 (and dependent claims 2, 4, 6-12, 14, 15, 17-19, and 30-32) "Agarwal teaches . . . forming a capacitor dielectric layer . . . *wherein the capacitor dielectric layer is formed of a crystallized material*".

After careful review of the Agarwal '630 reference, Applicant can find no such specific recitation or suggestion within the reference regarding the use of a crystallized

dielectric. Instead, paragraph 0048 of Agarwal '630 states only that the dielectric should have a high dielectric constant around 9, and that it be conformally formed as a "thin layer" over the enhanced surface area electrode (26) so that it preferably provides an enhanced surface area on a surface facing away from the bottom electrode. Paragraph 0055 states, in fact, that the anneal process is typically performed before the dielectric layer and second electrode are formed. And paragraph 0056 simply lists the suitable dielectric materials available. Applicant has already explained that other prior art such as Narwanka '203 does not teach that annealing the capacitor dielectric layer following its deposition inherently crystallizes it. The Examiner is encouraged to reread Applicant's prior responses for a full technical discussion of the issue.

Paragraph 8: "The admitted prior art teaches that it is *conventional in the art* to form a lower electrode by a CVD process using a source having carbon."

The Examiner has focused on the claim 1 and 13 limitation "having carbon." But using such carbon source creates inherent disadvantages as expressed in the background of the invention section. That is,

> "according to the analysis of present inventors, the large leakage current problem in the capacitor having the lower electrode made by the CVD method is due to impurities, e.g., carbons. The impurities are produced in the lower electrode when the metal organic source gas is not completely decomposed during the CVD process for forming the lower electrode. The impurities are thought to suppress the crystallization of the capacitor dielectric layer. Moreover, the impurities may induce defects in the capacitor dielectric layer, even though the impurities are too small amount to be detected by SIMS (Secondary Ion Mass Spectrometry) analysis. The defects act as sources of the leakage current." (page 1, line 32 to page 2, line 6).

It would not be obvious to use the CVD process using a source having carbon with the Agarwal process because of the inherent disadvantages. The pre-annealing process in the present invention is for the express purpose of alleviating this problem.

Paragraph 8: With respect to claim 20 (and dependent claims 24-29 as well as claims 6 and 17) "The pre-annealing of Agarwal *does not substantially change* the materiality of the lower electrode."

The process taught in Agarwal, however, clearly changes the materiality of the lower electrode. Paragraph 0035 discloses that the ruthenium oxide layer 12 is at least partially converted to ruthenium. This change is understood by those knowledgeable in the art to constitute a change in materiality. Accordingly, the present invention as stated in claims 6, 17 and 20-29 is clearly different from that taught in Agarwal.

For the foregoing reasons, reconsideration and allowance of claims 1, 2, 4, 6-15, 17-20 and 24-32 of the application as amended is solicited. The Examiner is encouraged to telephone the undersigned at (503) 222-3613 if it appears that an interview would be helpful in advancing the case.

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Respectfully submitted,

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